

## STABLE CHLORINE ISOTOPE STUDY OF MARTIAN SHERGOTTITES AND NAKHLITES; WHOLE ROCK AND ACID LEACHATES AND RESIDUES.

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**Introduction:** We have established a precise analytical technique for stable chlorine isotope measurements of tiny planetary materials by TIMS (Thermal Ionization Mass Spectrometry) [1], for which the results are basically consistent with the IRMS technique (gas source mass spectrometry) [2,3,4]. We present here results for Martian shergottites and nakhlites; whole rocks, HNO<sub>3</sub>-leachates and residues, and discuss the chlorine isotope evolution of planetary Mars.

**Experimental:** Whole rocks of Zagami (shergottite, basalt), Nakhla (nakhlite, basalt) and MIL03346 (nakhlite, basalt) and 1N-HNO<sub>3</sub> leachates and residues of Zagami and MIL samples were examined for chlorine contents by ion chromatography and isotopic composition by TIMS in this work. The 1N-HNO<sub>3</sub> leaching was carried out at room temperature for 15-20 hrs. Bulk and residue samples were analyzed for chlorine isotopes after treatment by HF leaching, AgCl precipitation and Cs-form resin. Isotopic analyses of leachates were also carried out by a similar method without HF-treatment.

**Results and Discussion:** *Leaching effect-* The 2<sup>nd</sup> Zagami sample subjected to leaching experiments shows higher total Cl abundance (160 ppm) compared to the 1st sample (114 ppm) reported at 42th LPSC [1], but rather similar abundance to that of Dreibus et al. [5] (145 ppm). About 60% of total chlorine in the bulk sample was leached out in the 1N-HNO<sub>3</sub> fraction, indicating that major parts of chlorine exist in soluble phases (for example, chlorapatite) in Zagami. On the other hand, only 20% of bulk MIL chlorine (221 ppm) was leached out in the acid fraction.

*Chlorine isotopic composition-* Our Orgueil (CI) results show significantly smaller  $\delta^{37}\text{Cl}_{\text{SMOC}}$  compared to that of Sharp et al. ( $\delta^{37}\text{Cl}_{\text{SMOC}} = 1.21\text{\textperthousand}$ ) [4] but still within the range of  $\delta^{37}\text{Cl}_{\text{S}}$  values reported by the New Mexico Univ. group [6]. Bulk Zagami, shergottite, shows  $\delta^{37}\text{Cl}_{\text{SMOC}}$  almost the same as seawater. On the other hand, Zagami leachate and two bulk nakhlites (Nakhla and MIL03346) show relatively similar  $\delta^{37}\text{Cl}_{\text{SMOC}}$  values ( $1.5 \pm 0.5\text{\textperthousand}$ ). In Martian meteorites, the acid leachates were considered to be derived from more leachable components such as fluids, suggesting that they might represent Martian crustal components [7].

**References:** [1] Nakamura N. et al., 2011. Abstract #2513 42th Lunar & Planetary Science Conference. [2] Bonifacie M. et al. 2007. Chem. Geol. 242, pp. 187-201. [3] Musashi M. et al. 1998. Anal. Chem. 363, pp. 261-269. [4] Sharp D.Z. et al. 2007, Nature 446, 10062-1064. [5] Dreibus G. et al. 1979. Origin & Distri. Elements pp. 33-38. [6] Mercer J. A. et al. 2011. abstract #2463 42th Lunar & Planetary Science Conference. [7] Sautter V. et al. 2006. Earth Planet Sci. Lett. 252, pp. 45-55.